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(71) Applicants
Blacks Equipment Ltd,
(United Kingdom),
Barton Lane,
Armthorpe,
Doncaster,
South Yorkshire,
DN3 3AA
(72) Inventor
George Alexander Black
(74) Agent and/or
Address for Service
Matthews Haddan and
Co,
Haddan House,
33 Elmfield Road,
Bromley,
Kent,
BR1 1SU

(54) **Belts or ropes suitable for haulage and lifts**

(57) A belt for use in a winding engine, winch, haulage or lift is formed by one or more ropes or cords on which a rubber coating is bonded which may be formed with teeth to engage a toothed drive wheel.

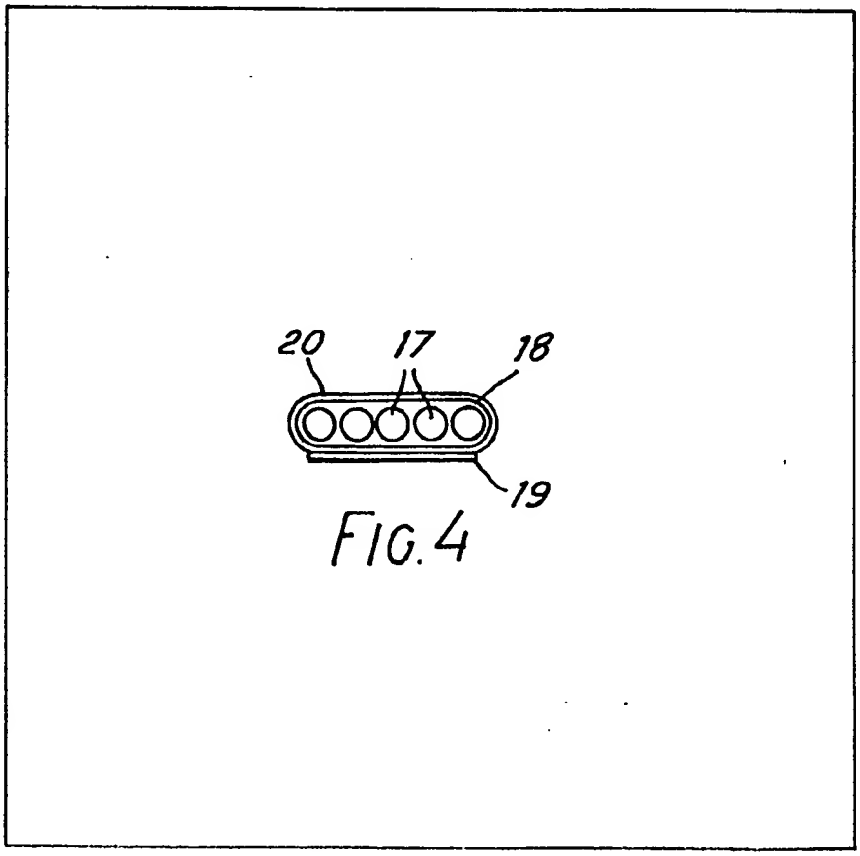

FIG. 4

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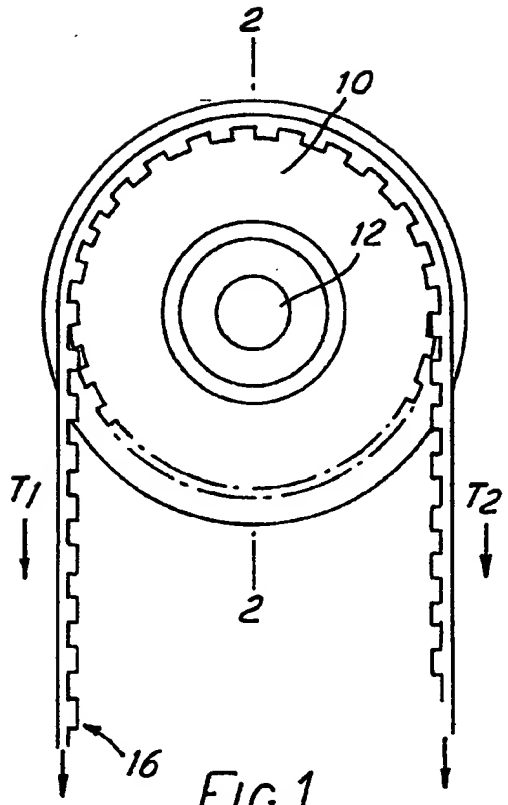

FIG.1

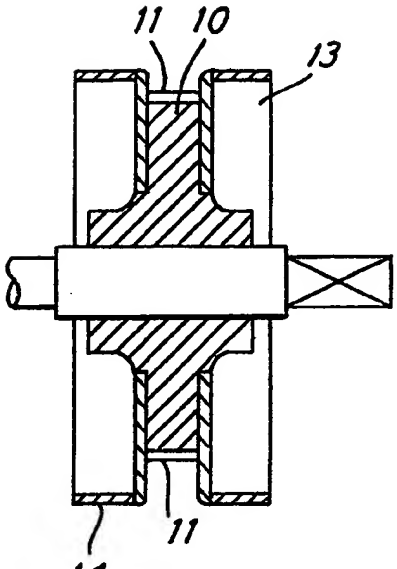

FIG.2

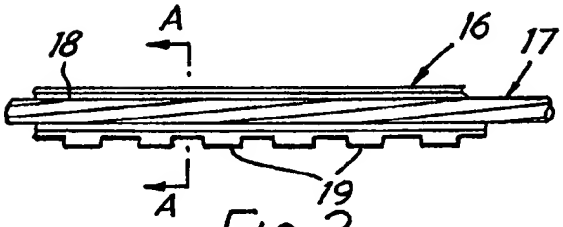

FIG.3

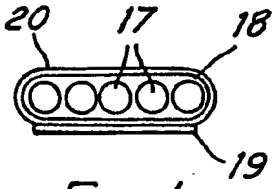

FIG.4

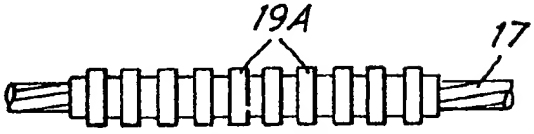

FIG.5

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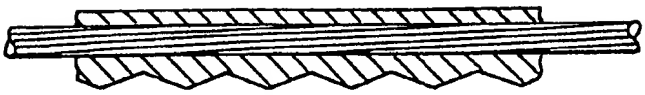


FIG.6

FIG.7

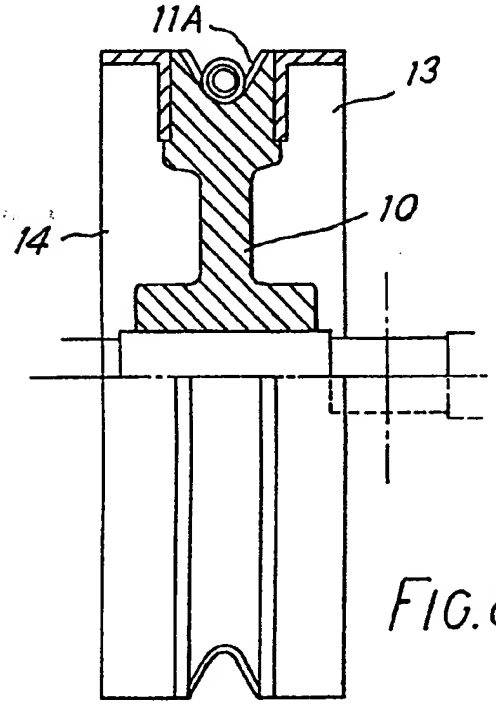


FIG.8

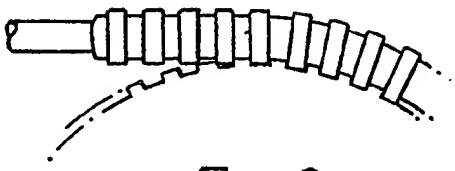
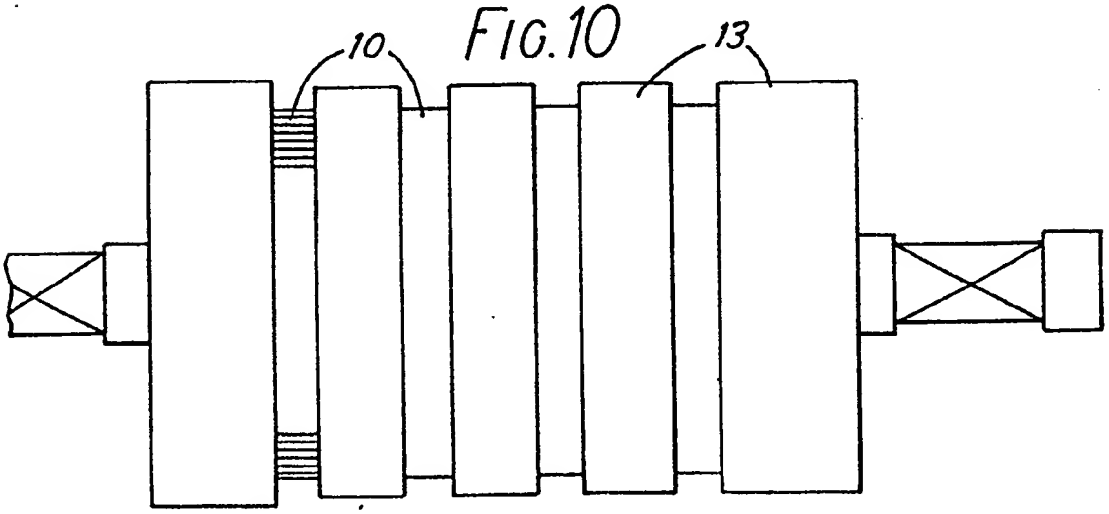


FIG.9

FIG.10



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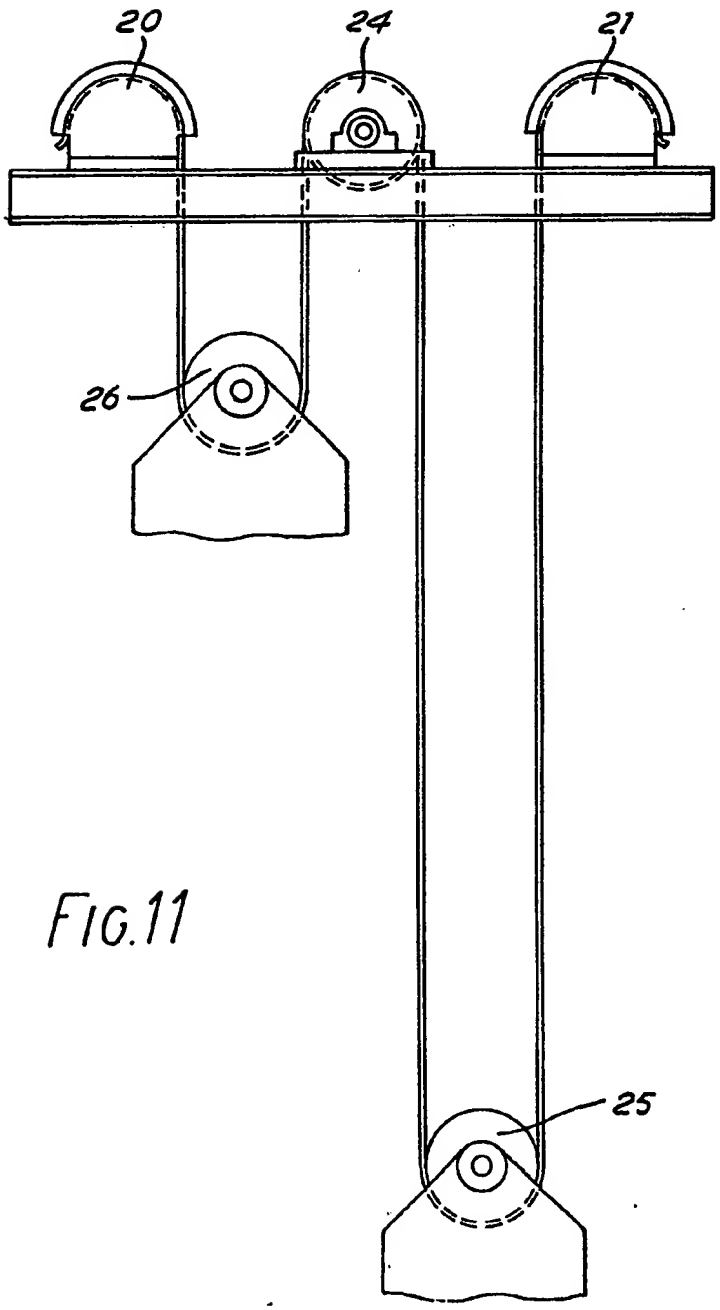

FIG.11

SPECIFICATION

Improvements in or relating to belts or ropes suitable for winders such as haulage and lifts

This invention relates to belts or ropes suitable for winding engines for example such as those installed in coal mines for raising and lowering the mine cages, or for winches, haulages or lifts.

One known form of winding engine, known as a Koepe winder, comprises a drive wheel having a single groove over which passes the winding rope attached at either end to the mine cage or one mine cage and one dead weight. From the underside of the cage a balance rope is attached so that with empty cages perfect balance exists throughout the entire wind. Winders using a plurality of ropes are also known.

Known winders do however suffer from certain disadvantages.

For example in calculating the maximum drive force available before slip would take place the basic formula is $T_1 = T_2 e^{\mu\theta}$ where μ is assumed not less than 0.2 slipping commences when $\frac{T1}{T2} = e^{\mu\theta}$ where θ = the arc of contact of the rope on the wheel in radians and e = 2.7183 Base of Napierian logarithms. From this it can be shown that the allowable acceleration or retardation is limited. For example the ratio of $\frac{T1}{T2}$ when the arc of contact is say 210° and $\mu = 0.2$ will be 2.0813 and this is the point at which slip would occur. This means that if under acceleration or retardation T_2 became 1 Ton and T_1 became 2.0813 Tons slip is on the point of occurring.

A further difficulty with the Koepe type winder is the fact that the difference between T_1 and T_2 as the system is accelerated or retarded causes creep to occur, which makes it necessary to incorporate a rope creep compensator.

Usually the drive wheel is lined with a friction material, elm wood and laminated polyvinyl chloride being the most popular materials, in order to create the maximum coefficient of friction between the tope and wheel, but from time to time the groove which is turned into this friction material has to be returned to restore the original contour.

It is an object of this invention to extend the limit of the drive force that can be transmitted between the wheel and the rope (or belt), thus increasing the possible acceleration or retardation.

Other objects are to eliminate tope creep and also the need for rope groove turning.

According to the present invention a belt suitable for winding engine, haulage, winch or lift comprising at least two ropes on to which rubber or rubber-like material is bonded and formed into a flat cross-sectional shaped belt. The term "rubber-like" is intended to include artificial rubber but preferably what is known as PVC which is impervious to deterioration when contaminated with mineral oils.

The drive belt may include a single steel rope or a plurality of steel ropes or hemp or cotton ropes may be used. For example the drive belt may include a plurality of steel ropes (more than two) having their centres in cross-section in a common plane surrounded by an envelope of the rubber or rubber-like material in which teeth may be moulded, each tooth extending across substantially the width of the drive belt.

The invention will be further described by way of example with reference to the accompanying diagrammatic drawings wherein:—

FIGURE 1 is an axial view of parts of a winding engine made in accordance with the invention;

FIGURE 2 is a sectional view on the plane 2-2 on Figure 1; and

FIGURE 3 to 8 show details to be described.

In Figures 1 and 2 a drive wheel 10 is formed with peripheral teeth 11 and is mounted on a drive shaft 12 which also carries brake drums 13,14. The drive belt 16 is made from a plurality of steel ropes 17 encased in a tough rubber-like material 18 which is moulded with teeth 19. In Figure 4 these teeth 19 are shown extending across substantially the full width of the drive belt. The teeth 19 and the outer surface 20 of the drive rope in section are straight lines parallel to each other. The teeth are dimensioned to cooperate with the teeth 11 of the drive wheel.

In figure 5 steel ropes 17 are encased in the material 20 which is formed with teeth 19A which in this example may encircle the steel rope.

Figures 6 and 7 show a belt made with zig-zag shaped teeth.

Figures 8 and 9 show the application of the single rope of Figure 5. The teeth 11A in this example have an approximately V-section with the bottom of the V curved to the shape of the drive belt.

Figure 10 shows a drive wheel having plurality of toothed drive wheel 10 and brake drums 13.

Figure 11 shows a desirable construction.

For a flat belt teeth may be provided on both sides.

The ends of the drive belt will be attached to the load in usual manner.

The 4 rope construction, due to the official requirement that the drive wheel must be approximately 100 times the diameter of the rope passing over it, reduces the diameter of the wheel to approximately half the diameter of the conventional single rope winder using a rope which is equivalent in breaking strain to the sum of the breaking strain of the 4 ropes. By using 4 flat belts each made up of 4 banded ropes of half the diameter of the 4 single ropes the diameter of the drive wheel or drum will be halved again to one quarter that of the Koepe type.

There is a practical limit to the number of ropes than can be employed in this manner but there is an advantage to be gained by an increase to, say, five or six ropes and that is, that the wider the flat rope the greater the tooth width and therefore area of tooth to transmit the acceleration and retardation forces. It would seem from calculation that the ideal flies around the four and five rope construction.

A further advantage can be gained from using the maximum number of ropes in the construction and that is for a given rope speed the maximum RPM of the drive wheel can come within the maximum speed of a standard AC induction motor. As an example; using a five rope construction of half inch diameter individual

ropes the wheel at 100 diameters becomes fifty inches diameter, and for a circumferential velocity of 3000 ft/mins the RPM of the wheel will be 230 RPM. The full load speed of a 24 pole AC motor would be of the same order. Therefore a very cheap direct coupled winder will result.

Thus the rope diameter may be selected so that the resulting RPM of the wheel corresponds to the full load RPM of a standard AC induction motor.

In the construction shown in Figure 11 the ends of the rope are clamped to static anchorage means 20, 21 and runs over fixed axis upper drive wheel 24 and lower pulley 25 and around a vertically moving pulley 26 which carries a conveyance or other load. In one example, a vertical speed of pulley 26 would be 3000 ft/min which results in the drive wheel 24 rotating at 733.3 RPM. If a 8 pole Ac induction motor is used to drive the wheel 24 the vertical speed of pulley 26 would be 3000 ft/min at 50 cycles. This augments the output of the winder and elimates the use of a reduction gearbox.

Normally 1 to 6 steel ropes may be embedded in a toothed plastics casing.

There are two types of rope stretch to be considered, namely permanent stretch (or so called constructional stretch) and elastic stretch due to the elastic properties of the metal comprising the rope and providing the rope is not loaded beyond its elastic limit, it will return to its original length if the load is removed.

The permanent stretch is unrecoverable and therefore should be eliminated before bonding the individual ropes into the rubber-like covering. The amount of permanent stretch varies according to the construction of the rope, for example:—

1. Six strand ropes with fibre main core will permanently stretch 0.5 to 0.75%.
2. Above but with steel wire core 0.25 to 0.5%.
3. Eight strand ropes with fibre core 0.75 to 1.0%.
4. Locked coil ropes with fibre core 0.1%.

The elastic stretch is so small that it can easily be tolerated.

The belt provided with teeth is especially suitable for engagement with a toother drive wheel of a winding engine.

The belt can also be used for brake drums.

If desired metallic pieces, e.g. magnetic pieces, such as studs or bars may be embedded in the cover at spaced intervals whereby these may be detected by electrical, e.g. electronic measuring means in order to provide an accurate measurement of travel of the belt and parts moved by it.

CLAIMS

1. A belt suitable for a winding engine, haulage, winch or lift comprising at least two ropes on to which a cover of rubber or rubber-like material is bonded and formed into a flat cross-sectional shaped belt.
2. A belt as claimed in claim 1, wherein said material is formed into teeth suitable for engagement with a toothed drive wheel.
3. A belt as claimed in claim 2, wherein the teeth are of involute shape.
4. A belt as claimed in claim 2, wherein the teeth are of zig-zag form.
5. A belt as claimed in any of claims 1-4 wherein the rope or each rope is a steel rope.
6. A belt as claimed in claim 5, wherein the steel rope of each steel rope has been prestressed to eliminate permanent stretch before bonding.
7. A belt as claimed in any of claims 1-4, wherein the rope or each rope is a hemp or cotton rope.
8. A belt as claimed in any of claims 1 to 6 comprising 3 to 6 ropes having their centres in a cross-section in a common plane surrounded by an envelope of rubber or rubber-like material.
9. A belt as claimed in any of claims 1 to 8 having metallic pieces embedded in the cover at spaced intervals suitable for detection by electrical measuring means.
10. A belt substantially as described with reference to any of the examples shown in the drawings.
11. A winding engine, lift, winch or haulage having a toothed driving wheel driven by a toothed belt as claimed in claim 2.

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